



First records of *Scotaena* Klug, 1810 species (Hymenoptera, Tiphidae, Thynninae) in the Brazilian Atlantic Rainforest

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Abstract

Scotaena is considered a dumping ground genus of the Neotropical thynnine, having both a complicated taxonomy and a poorly known geographical distribution. This work presents the first records of *Scotaena decora* (Smith, 1859), and *Scotaena polistoides* Turner, 1910 in 13 areas of the Brazilian Atlantic Rainforest in São Paulo state, Brazil. Both species were previously known only from their type localities, in Amazonia, Brazil and Chaco, Paraguay, respectively. These new records expand the range of distributions of both species to a new biome and contribute to the natural history of the genus.

Key words

Parasitoid wasps; Neotropics; Semideciduous Atlantic Forest.

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Introduction

Scotaena Klug, 1810 is one of the Neotropical genera within Thynninae, which is the most diverse subfamily of Tiphidae (Kimsey 1991, 2004a). As most of the other thynnine genera, *Scotaena* is poorly known in terms of biology, and systematics. The paucity of specialists and difficulty of identification has led to a troubled taxonomic history, resulting in many specimens deposited in collections over the years without further studies. Contributing to this scenario is the strong sexual dimorphism present in Thynninae, where females and males are completely different morphologically, and cannot be associated except when collected in copula (Kimsey 1991).

Considered a “dumping ground” by Genise and Kimsey (1991), *Scotaena* had never been revised, and many

species were described under it by simply not fitting into any other genera. Currently *Scotaena* includes 15 species: *S. brunnea* (Fox, 1898: 73); *S. clypearis* (Durand-Moya, 1941: 103); *S. decora* (Smith, 1859: 51–52); *S. duckei* Turner, 1909: 341–342; *S. fastuosa* (Smith, 1879: 170–171); *S. flavovariegata* (Smith, 1879: 170); *S. genisei* (Kimsey, 1991: 61–62); *S. horni* (Turner, 1927: 449); *S. pallida* (Fox, 1898: 74); *S. polistoides* Turner, 1910b: 182–183; *S. pubescens* (Klug, 1840: 31); *S. rosenbergi* (Turner, 1910b: 203); *S. trifasciata* Klug, 1810: 40, type species; *S. vetusta* Turner, 1909: 340–341; and *S. vigilii* (Brèthes, 1910: 217–218).

Little is known about the distribution range of the genus, and in fact, most species are known only from their type localities. *Scotaena* species are recorded from the following areas of South America: the Brazilian states of



Figure 1. *Scotaena decora* (male): **A.** Frontal head. **B.** Lateral habitus. *S. polistoides* (male): **C.** Frontal head. **D.** Lateral habitus. Scale bar = 1mm.

Bahia (Kimsey 1991, 2004a, 2004b), Ceará (Genise and Kimsey 1993; Kimsey 1992, 2004b, Turner 1910a), Espírito Santo (Azevedo et al. 2015), Minas Gerais (Genise and Kimsey 1993, Kimsey 1992, Turner 1910a), Mato Grosso (Fox 1898), Pará, and Paraná (Fox 1898, Turner 1910a); Argentina (Genise and Kimsey 1991); Bolivia (Kimsey 2004a, Turner 1910a); Chile (Genise and Kimsey 1993, 2004a); and Paraguay (Turner 1910b, Turner 1927). For *S. decora* (Fig. 1A, B) and *S. polistoides* (Fig. 1C, D), the only records available in the literature are from Santarém, Brazil, and Asunción, Paraguay, respectively. Herein, the first records of these 2 species from the Brazilian Atlantic Rainforest (BAR), São Paulo state, are presented.

Methods

The specimens were collected between 2007 and 2009 using Malaise traps (Townes 1962) in 13 areas of Semideciduous Atlantic Forest (SAF), 2 traps in each area. Traps were exposed for 1 yr in each area, and the samples were collected monthly. The areas are localized in northwest São Paulo state (Table 1). The collection expeditions

were part of the Thematic Project Biota/FAPESP–Invertebrates (grant number 2004/04820-3). The samples included 284 individuals: 270 of *Scotaena decora* and 14 of *S. polistoides*. Only males were collected because Malaise is a flight intercept trap, and females of Thynninae are fossorial wingless insects. All specimens are deposited in the Hymenoptera Collection, Department of Zoology and Botany, at the São Paulo State University (UNESP), São José do Rio Preto, São Paulo, Brazil. Collections were done under the authorization number: 283/2005/CTEC/DPG/SBF/MMA (UNESP).

Because there is no identification key, species were identified by comparison with type specimens deposited at the Natural History Museum, London, England (NHM-UK). Images were made through a Leica MZ 16 stereomicroscope coupled to a Leica DFC 295 digital camera. Distribution maps were produced with QGIS version 2.18.2. The shapefile used was obtained from the geographical data portal of the Ministry of the Environment (Ministério do Meio Ambiente) of Brazil (<http://mapas.mma.gov.br/i3geo/datadownload.htm>). When necessary, images, and maps were edited using Adobe Illustrator CS4. Biomes, ecoregions, and phyto-

Table 1. Locality, geographic coordinates, and number of specimens of the 2 *Scotaena* species collected in the Atlantic Forest in São Paulo state.

Species	Locality	Number of specimens	Latitude (S)	Longitude (W)
<i>S. decora</i>	Planalto	63	21°00'05"	049°58'26"
<i>S. decora</i>	Pindorama	6	21°13'12"	048°55'04"
<i>S. decora</i>	Taquaritinga	20	21°24'08"	048°41'14"
<i>S. decora</i>	União Paulista	12	20°55'16"	049°55'34"
<i>S. decora</i>	Matão	94	21°37'14"	048°32'14"
<i>S. decora</i>	Sales	5	21°21'17"	049°30'01"
<i>S. decora</i>	Vicentinópolis	19	20°55'34"	050°20'55"
<i>S. decora</i>	Votuporanga	36	20°30'52"	050°05'12"
<i>S. decora</i>	Palestina	3	20°17'18"	049°30'01"
<i>S. decora</i>	Magda	10	20°28'25"	050°17'36"
<i>S. decora</i>	Novo Horizonte	1	21°31'15"	049°17'41"
<i>S. decora</i>	Barretos	1	20°29'05"	048°49'21"
<i>S. polistoides</i>	Macaubal	12	20°44'34"	049°55'45"
<i>S. polistoides</i>	Planalto	1	21°00'05"	049°58'26"
<i>S. polistoides</i>	Magda	1	20°28'25"	050°17'36"

physiognomies are referred in the text by the initials: AF, Amazonian Forest; AN, Andean Forest; BAR, Brazilian Atlantic Rainforest; CA, Caatinga; CE, Cerrado; CH, Chaco; SAF, Semideciduous Atlantic Forest.

Results

These 2 species can be identified by the following characters:

Scotaena decora (Fig. 1A, B) has the apical margin of clypeus with a shallow central notch, with depth of about $\frac{1}{5}$ of the clypeus length; the teeth formed laterally to the notch is soft, not acute, and point slightly to the sides, and the basolateral margins of the clypeus are angulated; epipygium presents well-marked, deep, and stretched punctuations, producing longitudinal striae that converges towards the border of the epipygium.

Scotaena polistoides (Fig. 1C, D) has the apical margin of clypeus with medium central notch, with depth of about $\frac{1}{5}$ of the clypeus length; the apical teeth acute and point downwards; basolateral margins of the clypeus slightly rounded; spiracles of the first metasomal tergite strongly raised.

Discussion

The type specimen of *S. decora* is from Santarém, Pará state, Brazil, in Tropical and subtropical moist broadleaf forest ecoregion of the AF (WWF 2017a); and *S. polistoides* is from Asunción, Paraguay, in the Chaco Humedo ecoregion of the Humid CH (WWF 2017a). The new records for both species are in transition zones with CE, part of the SAF (Fig. 2). Previous and new records, when plotted together (Fig. 2), show that the genus has a wide distribution in South America.

The SAF is one of the 2 main phytobiogeographies of the BAR, which passes through the center and southeastern to northeastern of Brazil (Morellato and Haddad 2000). The BAR is one of the largest rainforests of

South America (Fundação SOS Mata Atlântica 2017) and is a well-defined South American region, with open, semiopen, and xeric areas of CA, CE, and CH separating it from AF and AN (Ab'Saber 1977). The CH is a biogeographic region composed by elements from different biomes (Werneck 2011), with xerophytic (Dry CH), and mesoxerophytic vegetation (Humid CH) (Mereles 2005). The latter is characterized in most part by savanna vegetation, but deciduous, semideciduous, and xerophilous forests are also present (Ramella and Spichiger 1989). The CE, the other corridor between AF and AN, is part of the “dry diagonal” biomes in South America, bordered on the northeast by the CA and the southwest by CH (Werneck et al. 2012). The CE landscape is characterized by plateaus of savanna (composed by xeromorphic natural pastures, tall coarse grass, shrubs, and trees), and forested valleys (composed by heterogeneous dry, and gallery forest vegetation) (Werneck 2011, WWF 2017a).

The distributional gaps observed between the type localities and the new records of *S. decora* and *S. polistoides* may reflect the natural history of the biomes and phytobiogeographies, since the BAR was once connected with the AF and AN during the Miocene (Silva et al. 2004, Batalha-Filho 2013). The isolation emerged between these biomes could have produced the current disjunct geographical distribution in these species. As observed for *S. decora*, it is common to find species and populations with disjunct distributions in the BAR and AF (Batalha-Filho 2013), shaped by historical fragmentation (Kaňuch et al. 2017). The presence of *S. polistoides* in the CH and BAR could indicate either that this species has a continuous distribution between the BAR and AF through the CH corridor (unconfirmed until now because of no records from the AF and AN) or that it naturally occurs from the Humid Chaco to the CE and transition zones with the BAR. Even though not recorded yet, the presence of this species in the CE could be expected, because the diversity of this region is mainly historically determined by biotic interchanges between the adjacent

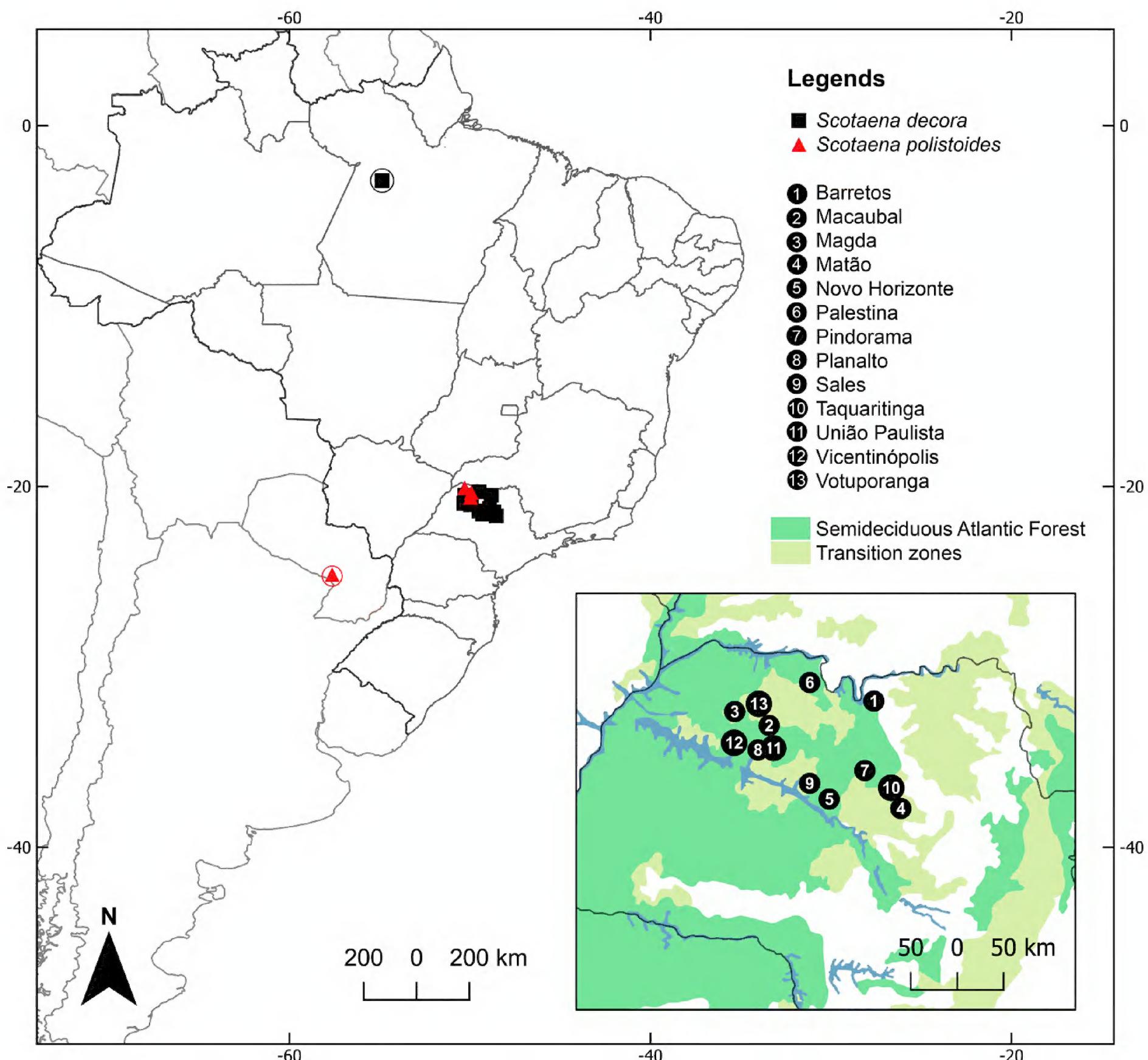


Figure 2. Distribution of *Scotaena decora* (black squares) and *S. polistoides* (red triangles) in South America. New records are confined to northwest São Paulo state. Symbols in circles indicate the type locality of each species. At the right bottom, a detail of northwest São Paulo state showing the areas where the new records of the species were obtained. Geodetic datum: SIRGAS 2000.

forests, like the AF and BAR (Werneck 2011).

The known ranges of these species are currently determined by just a few records each. The scarcity of geographical data is a recurrent difficulty within the tephritids and it is a consequence of a lack of properly identified specimens in entomological collections, and poor sampling and collecting efforts. The original descriptions of most species are insufficient. The difficulty of species-level identification is a well-known barrier for further research on Tephritidae; keys are available for just a few genera (Genise and Kimsey 1993, Kimsey 1991b, 1996, 2005).

The BAR has experienced massive habitat loss with expansion of the agricultural landscapes and monocultural exploration, making this habitat a global priority for biodiversity conservation (Ribeiro et al. 2011). Recently, new records for *Upa* Kimsey, 1991 (Tephritidae, Thynninae) were found in the same areas of SAF, in Barretos,

Matão and União Paulista (Justino et al. 2013), which reinforces that poor sampling of Thynninae in these areas may be a reason for the current observed distribution. An ecological study of Tephritidae from the BAR (Justino et al. 2016) showed that even in areas with enormous fragmentation, such as the SAF, there are many species yet to be recorded and discovered. Justino et al. (2016) revealed the presence of 2 unidentified *Scotaena* species, herein identified as *S. decora*, and *S. polistoides*.

The AF, BAR, CE, and CH are all classified as vulnerable habitats (WWF 2017a, WWF 2017b) and their conservation depends initially on knowing the species present in these areas. Especially for insect groups like Tephritidae that remain scarcely known in terms of taxonomy, biology, geographical distribution, and ecological functions, new distributional data are fundamental to implementing and improving conservation policies for these vulnerable habitats. Thus, further collection and

inventory are needed to better understand the distribution of these and other Tiphidae species.

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Authors' Contributions

JCEL and FBN collected the data. FHC identified the species. All authors wrote and reviewed the manuscript.

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